Effects of Maintenance Dredging on Groundwater

at Mattawoman Bar, Potomac River

Based on both new and existing scientific investigations, Mattawoman channel maintenance dredging will pose no threat to groundwater supplies or groundwater quality in the region.

The Mattawoman Bar portion of the channel lies adjacent to the Naval Ordnance Station (NOS) and the town of Indian Head. This is an area of high-volume groundwater pumpage that dates back to the late 1800's. It is also an area that has experienced some saltwater intrusion in wells located closest to the river. While pumping rates have decreased slightly in recent years on NAS, the housing development in Charles County (and subsequent water demand) has increased public concerns about a sustainable fresh water supply.

Fortunately, there has been considerable scientific investigation into the subject. The Maryland Geological Survey (MGS) has conducted two groundwater modeling investigations (Mack and Mandle, 1977; and Andreasen and Mack, 1998). The United Stated Geological Survey (USGS) has also conducted two investigations (Fleck and Wilson, 1990; and Hiortdahl, 1997). In addition to these studies, the US Corps of Engineers has performed geologic coring of the Mattawoman channel bottom to supplement the above reports and answer certain questions that were posed.

Groundwater quality in the Indian Head area has gradually changed in a zone of the aquifer that is adjacent and parallel to the Potomac River. The chemical quality of water in this zone has changed from the native sodium bicarbonate-type water with a low dissolved-solids concentration (less than 250 mg/L) to a sodium chloride-type water with a comparatively higher dissolved-solids concentration (greater than 500 mg/L). Hiortdahl (1997) attributes this primarily to over-pumping of the aquifer. Large-scale groundwater pumping began about 1900. This was also the beginning of the decline in water levels in the Potomac Group aquifer. By the 1930's, the "cone of depression" (which refers to the water table surface around a pumping well) had been lowered to depths of up to 100 feet below sea level (Hiortdahl, 1977). Through time, this water-table depression has grown larger and has altered the natural flow of groundwater. In a natural system, rainwater percolates downward to the water table. Now called groundwater, it flows from the highland areas toward the river, and eventually discharges into the river. When a groundwater depression is created next to a river, groundwater flow directions reverse and water flows from the river into the pumping wells. According to Hiortdahl (1997), "It appears that, during much of this century, water from the Potomac River has provided recharge to the Potomac Group Aquifer system in the Indian Head area."

The maximum measured level of chloride and Total Dissolved Solids (TDS) reported by the USGS was 206 ml/L and 765 ml/L, respectively. This well (Cb 34) is located only a few hundred feet from the shoreline of the Potomac and has sustained pumping rates up to 250 gal/min. The EPA Maximum Contaminant Level (MCL) for chloride and TDS is 250 mg/L and 500 mg/L, respectively.

The flow velocity of this river water through the clays, sands, and gravels of the Potomac Group, however, is quite slow. Groundwater from selected wells across the length of the Indian Head peninsula was age dated using tritium and organic carbon. Results of this testing show that the water from these wells entered the groundwater flow system before 1952 (the first date that tritium entered the atmosphere from above-ground bomb testing.) The organic carbon data also support this date. This holds true even for the wells located within a few hundred feet of the river.

It is easy to mistakenly correlate the saltwater intrusion (which was first noticed in the 70's) with the last dredging of the Mattawoman Channel (1965). The age testing discussed above conclusively disproves this correlation. The water pumped from the wells in 1988 (the date of the tritium testing) began its path from the river toward the wells between 1900 and 1952, long before the 1965 dredging of the channel.

Between the aquifer and the river there is a layer of recently deposited clay or "muck" which exhibits extremely low conductivity. This clay layer protects the aquifer, to a degree, from the effects of salt-water intrusion. Removal of

this clay layer *could* increase saltwater intrusion by exposing river water directly to porous aquifer material. This is happening naturally, as is seen in the deep erosional channels (or thalwegs) of the present river.

To test the thickness of the clay layer at the bottom of the Mattawoman Channel, the Corps installed three new borings. One is located at each end of the dredged channel, and one in the middle (Figure 1). These borings show that there is a minimum of 26 feet of clay in the bottom of the Mattawoman channel (north end). This clay layer increases to a thickness of 52 feet on the south end of the channel (Table 1). Because the maintenance dredging will only remove 4 to 5 feet of this clay material, it is apparent that the aquifer will maintain a thick layer of clay (greater than 20 feet) after dredging is complete.

Table 1.

Mattawoman Channel Boring Results

Borehole	River Bottom, in ft. from MLLW	Bottom of Clay, in ft. from MLLW	Clay Thickness (ft.)
MWB-1	-22.3	-48.3	26
MWB-2	-19.7	-54.7	35
MWB-3&3A	-23.3	-75.8	52.5

Final drilling logs for these borings, including grain size analysis with hydrometer are included as Attachment A. Note that boring MWB-3 had to be terminated before final depth due to inclement weather. Boring MWB-3A was drilled at the same location and was completed to the desired depth.

References Cited:

Andreasen, D. C., and Mack, F. K., 1998, Evaluation of the Geohydrology and Water-Supply Potential of the Lower Patapsco and Patuxent Aquifers in the Indian Head-Bryans Road Area, Charles County, Maryland: Initial Findings: Open-File Report No. 98-02-9

Fleck, W. B., and Wilson, J. M., 1990, Geology and hydrologic assessment of coastal plain aquifers in the Waldorf area, Charles County, Maryland: Report of Investigations No. 53, 138 p.

Hiortdahl, S. N., 1997, Geologic Framework, Hydrogeology, and Ground-water Quality of the Potomac Group Aquifer System, Northwestern Charles County, Maryland: USGS Water-Resources Investigations Report 91-4059, 111p.

Mack, F. K., and Mandle, R. J., 1977, Digital simulation and prediction of water levels in the Magothy aquifer in southern Maryland: Maryland Geological Survey Report of Investigations No. 28, 42 p.

Attachment A

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION
SUBSURFACE EXPLORATION NOTES

1. EXPLORATION WAS PERFORMED DURING APRIL 1999.

2. EXPLORATION WAS ACCOMPLISHED USING THE CME 45 DRILLING RIG MOUNTED ON A 20' X 22' BARGE. SAMPLING WAS ACCOMPLISHED BY DRIVE A 1-3/8"ID SPLIT SPOON SAMPLER W/ A 140# HAMMER FALLING 30". BLOW COUNTS SHOWN ARE FOR 0.5' OF DRIVE UNLESS OTHERWISE INDICATED.

   WH - DENOTES WEIGHT OF HAMMER

   WR - DENOTES WEIGHT OF ROD

3. BLOW COUNTS REQUIRED TO ADVANCE SAMPLE SPOON ARE SHOWN IN COLUMN (a).

4. COLUMN (b) SHOWS THE NATURAL WATER CONTENTS IN PERCENT OF DRY WEIGHT OF THOSE SAMPLES TESTED.

5. SOIL DESCRIPTIONS ARE SHOWN IN COLUMN (c).

6. SOIL DESCRIPTIONS ARE LABORATORY CLASSIFICATIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487/2488).

7. DEPTH OF RIVER WATER SHOWN ON EACH BORING LOG WAS DETERMINED BY SOUNDING RIVER WITH A WEIGHTED TAPE PRIOR TO START OF SAMPLING. CONCURRENT WITH DEPTH SOUNDING, TIDAL READINGS WERE OBTAINED FROM NOAA'S AUTOMATIC GAUGE AT WASHINGTON D.C.

8. ELEVATIONS(MLLW) SHOWN ON BORING LOGS ARE BOTTOM OF RIVER SURFACE ELEVATIONS AT TIME OF EXPLORATION. THEY WERE DETERMINED BY ADJUSTMENT TO DEPTH SOUNDINGS IN ACCORDANCE WITH TIDAL READINGS.

   BORINGS WERE LOCATED BY COE SURVEYORS, USING A STARLINK DNAV-212G GPS SYSTEM. THIS SYSTEM PROVIDES BETTER THAN 1 METER HORIZONTAL ACCURACY

   VERTICAL DATUM: NAVD 88(NORTH AMERICAN VERTICAL DATUM) M.L.L.W., FOR THE '60 TO '78 TIDAL EPOCH. HORIZONTAL DATUM: NORTH AMERICAN 1927 DATUM, MARYLAND STATE PLANE COORDINATE SYSTEM.

9. FOR LOCATIONS OF SUBSURFACE EXPLORATIONS, SEE BORING LOCATION PLAN.

STA.
OFFSET:
TOP ELEV: -22.3 MLLW

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION

N 337495.0
E 1254491.0
COMPLETED: April 16, 1999

MWB-1
1 of 1

DEPTH (ft)	(c)	(d)	(a)	(b)
	Bottom of Channel : -22.3' MLLW			
	Wet, olive gray, fat CLAY w/ tr. fine sand (CH)		WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WR-WR	
	(-34.3' to -36.3') Trace brown organic material		WR-WR-WR-WR	
	(-38.3' to -42.3') Trace shell fragments		WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WH-WH	
			WR-WR-WH-2	
-48.3'			WR-WH-4-13	
	Very moist, brown, poorly graded GRAVEL w/ clay & sand (GP-GC)		10-26-53-60	
-50.3'				
	Wet, brown, poorly graded GRAVEL w/ clay & sand (GP-GC)		40-23-28-22	
-52.3'				
	BOTTOM OF HOLE			
	NOTE: Boring was drilled in the Potomac River. Depth of water prior to sampling 25.2'(relative to barge deck) @ 0834 hrs, with a tidal reading of +2.9'.			

MWB-1
GROUNDWATER DATA
▽ WHILE DRILLING:
▽ ON COMPLETION:
▼ Hr. READING:

Fill Auger SPT RB Cored

GDI-2 POTOMAC.GPJ 5/14/99 1253

STA.
OFFSET:
TOP ELEV: -19.7 MLLW

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION

N 331192.0
E 1249421.0
COMPLETED: April 15, 1999

MWB-2
1 of 2

DEPTH (ft)	(c)	(d)	(a)	(b)
	Bottom of Channel: -19.7' MLLW			
-21.7'	Wet, olive gray, lean CLAY w/ tr. fine sand (CL)		WR-WR-WR-WR	
	Wet, olive gray, fat CLAY w/ tr. fine sand (CH)		WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WR-WR	
-29.7'			WR-WR-WR-WR	
	Very moist, fat CLAY w/ tr. fine sand (CH)		WR-WR-WR-WR	
-31.7'				
	Very moist, very dk. gray, fat CLAY w/ tr. fine sand (CH)		WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WR-WR-WR	
			WR-WH-WH-WH	
-41.7'			WR-WR-WR-WR	
	Very moist, very dk. gray, fat CLAY w/ sand & tr. organic matter (CH)		WR-WR-WR-WR	
-43.7'				
	Very moist, very dk. gray, fat CLAY w/ tr. fine sand (CH)		WR-WR-WR-WR	
			WR-WR-WH-WH	
			WH-WH-WH-WH	
-49.7'				
	Very moist, very dk. gray, fat CLAY w/ tr. fine sand & organic matter (CH)		WR-3-3-2	
-51.7'				
	Wet, very dk. gray, fat CLAY w/ sand (CH)		WR-WR-WR-WH	
-53.7'				
-54.7'	Very moist, very dk. gray & grayish brown fat CLAY w/ sand (CH)		WR-WH-5-29	
-55.7'	Wet, dk. grayish brown, clayey GRAVEL w/ sand (GC)		18-20-23-30	
-57.7'	Slightly moist, gray & dk. yellowish brown, sandy fat CLAY (CH)			
	BOTTOM OF HOLE			

MWB-2
GROUNDWATER DATA
▽ WHILE DRILLING:
▽ ON COMPLETION:
▼ Hr. READING:

Fill Auger SPT RB Cored

STA.
OFFSET:
TOP ELEV: -19.7 MLLW

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION

N 331192.0
E 1249421.0
COMPLETED: April 15, 1999

MWB-2
2 of 2

DEPTH (ft) | (c) | (d) | (a) | (b)

NOTE:
Boring was drilled in the Potmac River.

Depth of water prior to sampling 19.9'(relative to barge deck) @ 1400 hrs., with a tidal reading of +0.2'.

Fill | Auger | SPT | RB | Cored

GEO-2 POTMAW.GPJ 5/11/00 14:47

STA.
OFFSET:
TOP ELEV: -23.3 MLLW

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION

N 325751.0
E 1245160.0
COMPLETED: April 14, 1999

MWB-3
1 of 2

DEPTH (ft)	(c)	(d)	(a)	(b)
	Bottom of Channel: -23.3' MLLW			
-25.3'	Wet, olive gray, fat CLAY w/ tr. fine sand (CH)		WR-WR-WR-WR	
-27.3'	Wet, dk. gray & olive gray, fat CLAY w/ tr. fine sand (CH)		WR-WR-WR-WR	
-31.3'	Wet, olive gray, fat CLAY w/ tr. fine sand (CH) w/ trace brown organic material		WR-WR-WR-WR WR-WR-WH-WH	
-33.0'	Very moist, fat CLAY w/ tr. fine sand (CH)		WR-WH-WH-WH	
-35.3'	Very moist, dk. gray & olive gray, fat CLAY w/ tr. fine sand (CH)		WH-WH-WH-WH	
-37.3'	Very moist, very dk. gray, fat CLAY w/ tr. fine sand (CH)		WH-WH-1-3	
-43.3'	Very moist, very dk. gray, fat CLAY w/ tr. fine sand & organic matter (CH) w/ wood fragments & roots		WR-WR-WR-WR WR-WR-WR-WH WR-WR-WH-WH	
	Very moist, very dk. gray, fat CLAY w/ tr. fine sand (CH) w/ tr. organic material		WH-WH-WH-WH WR-WR-WR-WR WR-WR-WH-WH WH-WH-WH-WH WH-WH-WH-1 WH-WH-1-2 WR-WH-WH-WH 2-3-3-2 WH-1-2-2 WR-WR-WH-WH	

MWB-3
GROUNDWATER DATA
▽ WHILE DRILLING:
▽ ON COMPLETION:
▽ Hr. READING:

Fill Auger SPT RB Cored

GB-2 POTOMAC 1/17/99 SHS

STA.
OFFSET:
TOP ELEV: -23.3 MLLW

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION

N 325751.0
E 1245160.0
COMPLETED: April 14, 1999

MWB-3
2 of 2

DEPTH (ft)	(c)	(d)	(a)	(b)
-65.3'	Very moist, very dk. gray, fat CLAY w/ tr. fine sand (CH) w/ tr. organic material		WR-WH-WH-2	
	BOTTOM OF HOLE			

NOTE:
Boring was drilled in the Potomac River.

Depth of water prior to sampling 25.2'(relative to barge deck) @ 0856 hrs, with a tidal reading of +1.9'.

Fill Auger SPT RB Cored

GEO-2 POTMWB.GPJ 5/17/00 07:53

STA.
OFFSET:
TOP ELEV: -23.8 MLLW

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION

N 325739.0
E 1245168.0
COMPLETED: April 15, 1999

MWB-3A

DEPTH (ft)		(c)	(d)		(a)	(b)
		Bottom of Channel: -23.8' MLLW				
		(-23.8' to -65.8') NOT SAMPLED			JETTED	

MWB-3A
GROUNDWATER DATA
∇ WHILE DRILLING:
∇ ON COMPLETION:
∇ Hr. READING:

Fill | Auger | SPT | RB | Cored

STA.
OFFSET:
TOP ELEV: -23.8 MLLW

POTOMAC RIVER, MD.
MATTAWOMAN CHANNEL INVESTIGATION

N 325739.0
E 1245168.0
COMPLETED: April 15, 1999

MWB-3A
2 of 2

DEPTH (ft)	(c)	(d)	(a)	(b)
	(-23.8' to -65.8') NOT SAMPLED			
-65.8'				
	Very moist, very dk. gray, fat CLAY w/ tr. fine sand (CH)		2-2-1-2	
			1-2-1-1	
			1-2-2-2	
			2-2-2-1	
-73.8'				
	Very moist, very dk. gray & brown, fat CLAY w/ fine sand (CH)		2-3-4-6	
-75.8'				
	Very moist, gray & yellowish brown, poorly graded SAND w/ clay & gravel (SP-SC)		4-10-13-7	
-77.8'				
	Very moist, dk. grayish brown, poorly graded SAND w/ clay & gravel (SP-SC)		8-11-20-14	
-79.8'				
	BOTTOM OF HOLE			

NOTE:
Boring was drilled in the Potomac River.

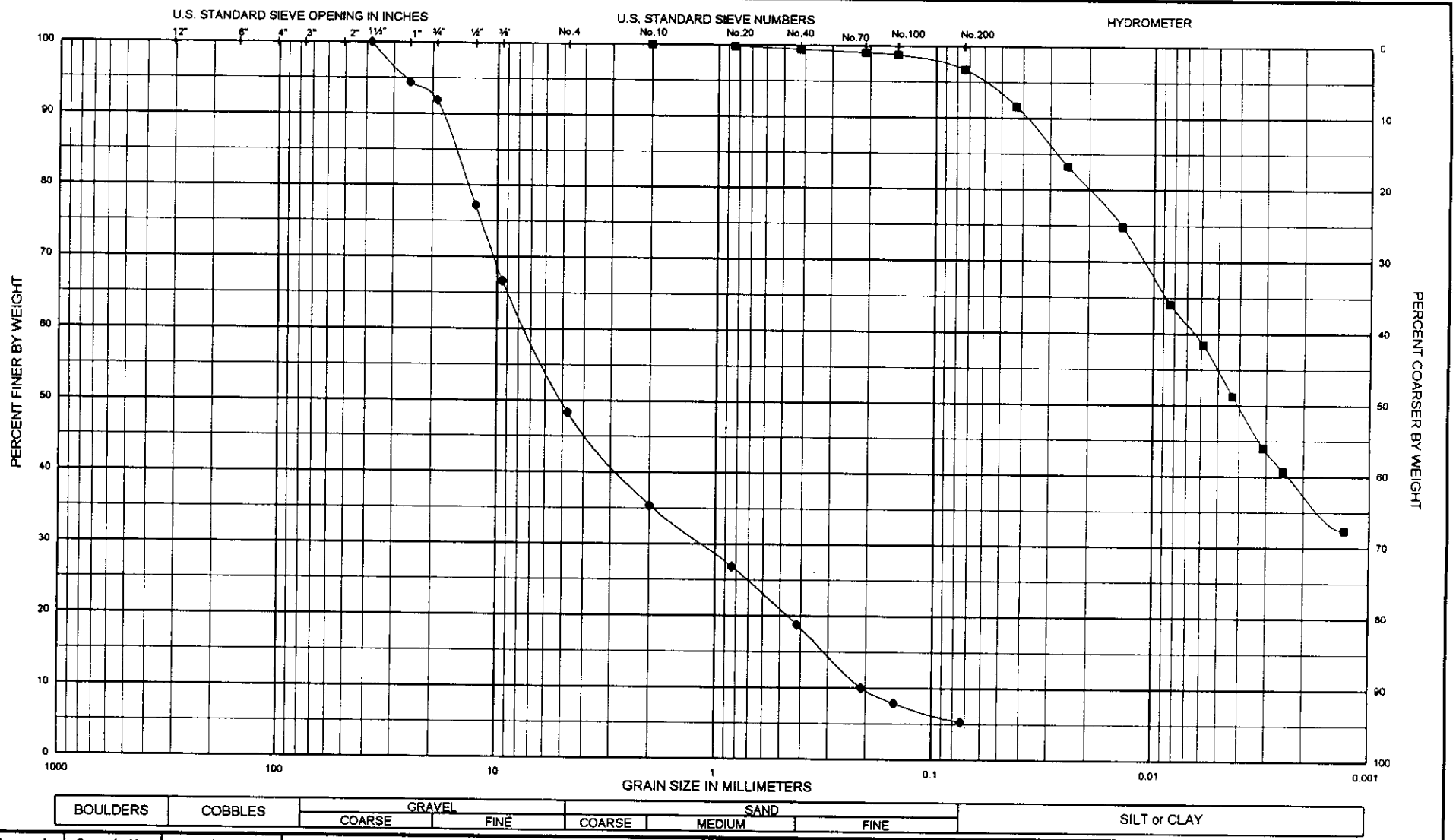
Depth of water prior to sampling 26.3'(relative to barge deck) @ 0806 hrs, with a tidal reading of +2.5'.

This boring was drilled as a continuation of MWB-3, located near the original boring.

The hole was advanced to 42.0'(-65.8' MLLW) below channel bottom(bottom of MWB-3) by jetting 4" casing. Sampling was started at this depth.

Fill | Auger | SPT | RB | Cored

GEO-2 POTMAN.GPJ 5/14/99 14:59



Legend	Sample No.	MLLW (ft)	Classification	Nat w%	LL	PL	PI
■	Jar-4	-28.3 to -30.3	Fat clay (tr. sand) (CH)	——	85	35	50
◆	Jar-15	-50.3 to -52.3	Poorly graded gravel with clay and sand (GP-GC)	——	——	——	——

ENG FORM 2087

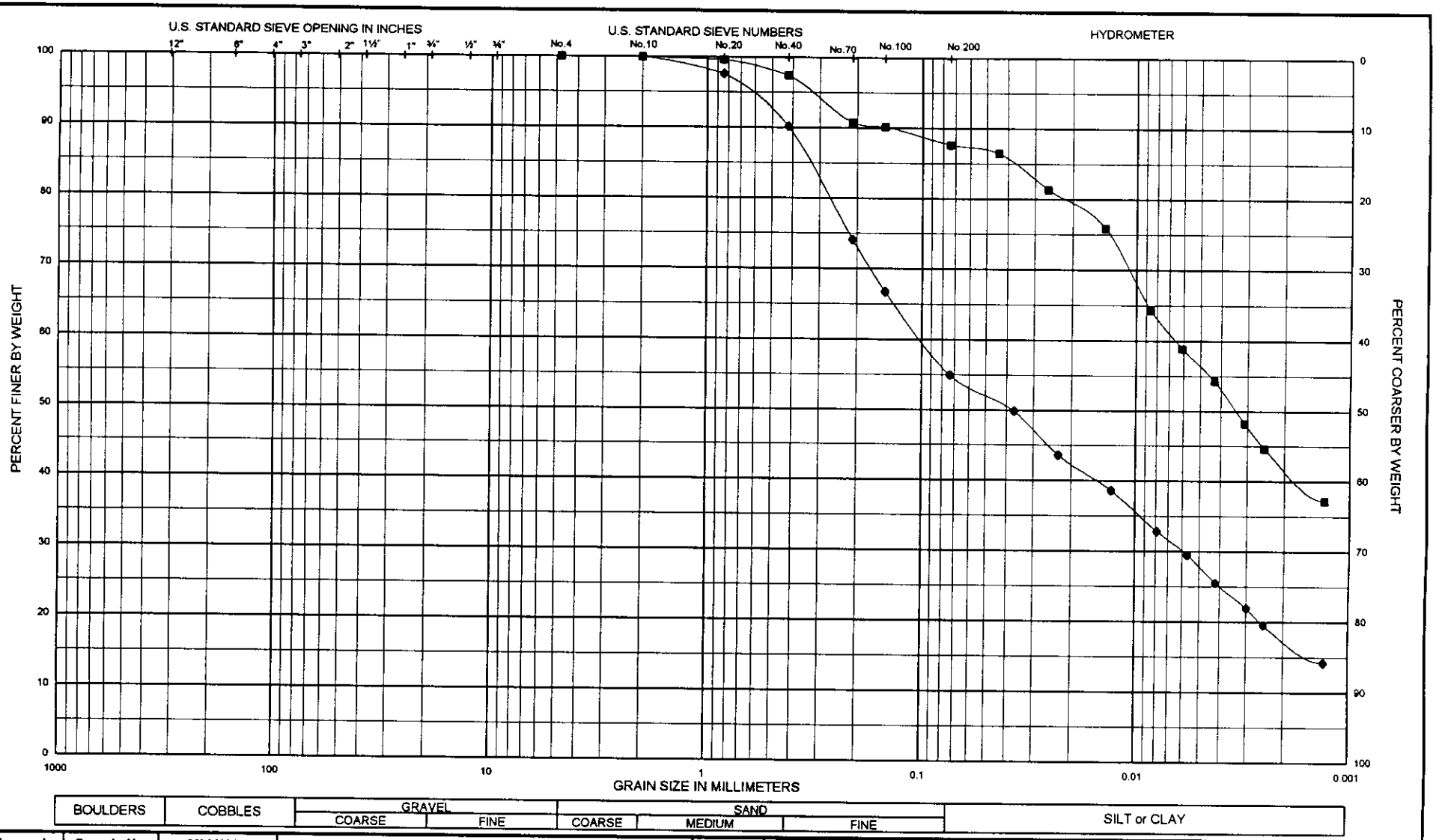
GRADATION CURVES

PROJECT: Ptomac River
Mattawoman Channel Investigation

AREA: Ptomac River, MD

Boring No.: MWB-1

DATE: May 1999



Legend	Sample No.	MLLW (ft)	Classification		Nat w%	LL	PL	PI
—■—	Jar-6	-29.7 to -31.7	Fat clay (tr. sand)	(CH)	———	———	———	———
—◆—	Jar-20	-55.7 to -57.7	Sandy fat clay	(CH)	———	———	———	———

ENG FORM 2087

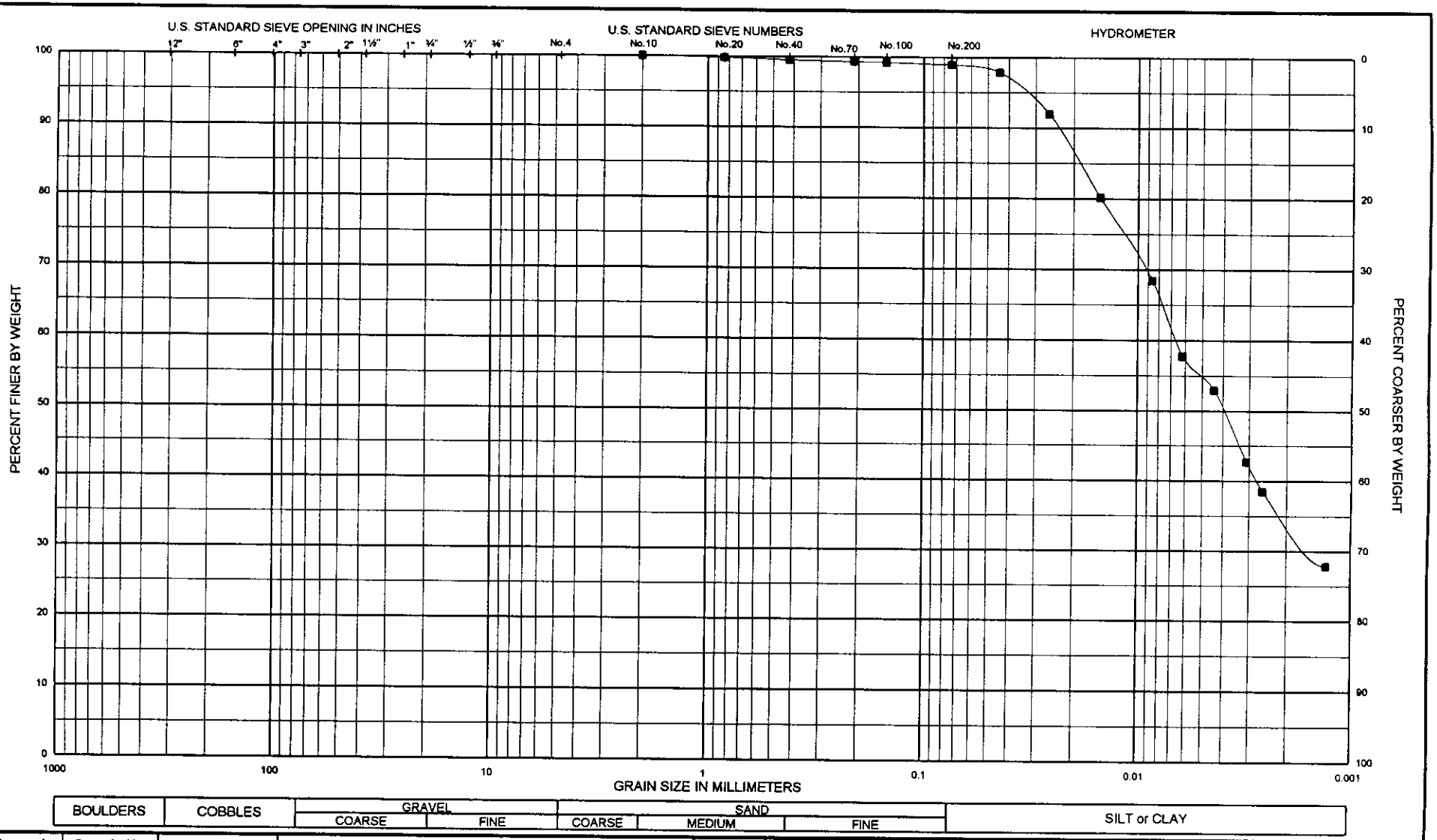
GRADATION CURVES

PROJECT: Ptomac River
Mattawoman Channel Investigation

AREA: Ptomac River, MD

Boring No.: MWB-2

DATE: May 1999



Legend	Sample No.	MLLW (ft)	Classification	Nat w%	LL	PL	PI
—■—	Jar-5	-31.3 to -32.3	Fat clay (tr. sand) (CH)	———	———	———	———

ENG FORM 2087

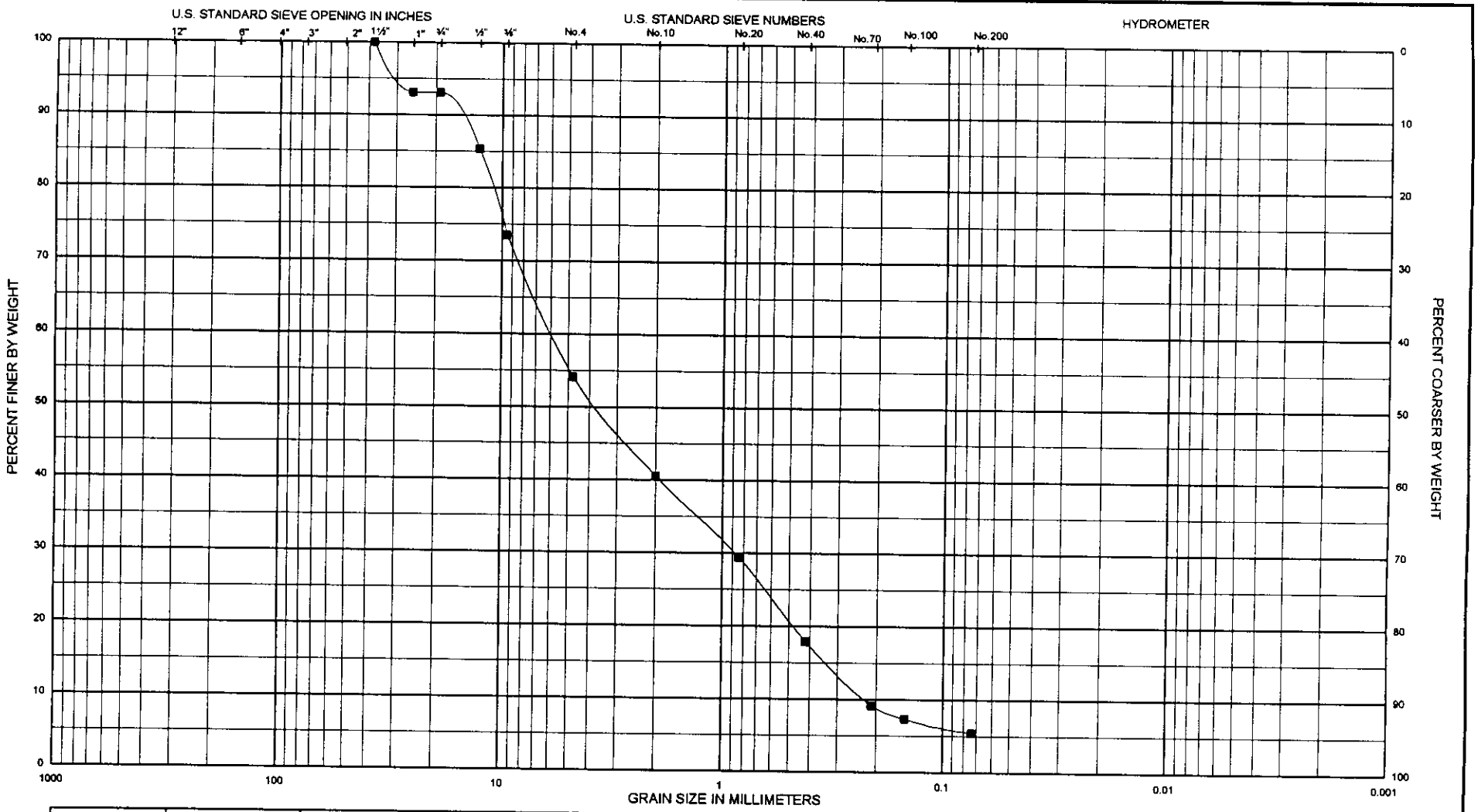
GRADATION CURVES

PROJECT: Ptomac River
Mattawoman Channel Investigation

AREA: Ptomac River, MD

Boring No.: MWB-3

DATE: May 1999



BOULDERS	COBBLES	GRAVEL		SAND			SILT or CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

Legend	Sample No.	MLLW (ft)	Classification	Nat w%	LL	PL	PI
—■—	Jar-6&7	-75.8 to -77.9	Poorly graded sand with clay and gravel (SP-SC)	———	———	———	———

ENG FORM 2087

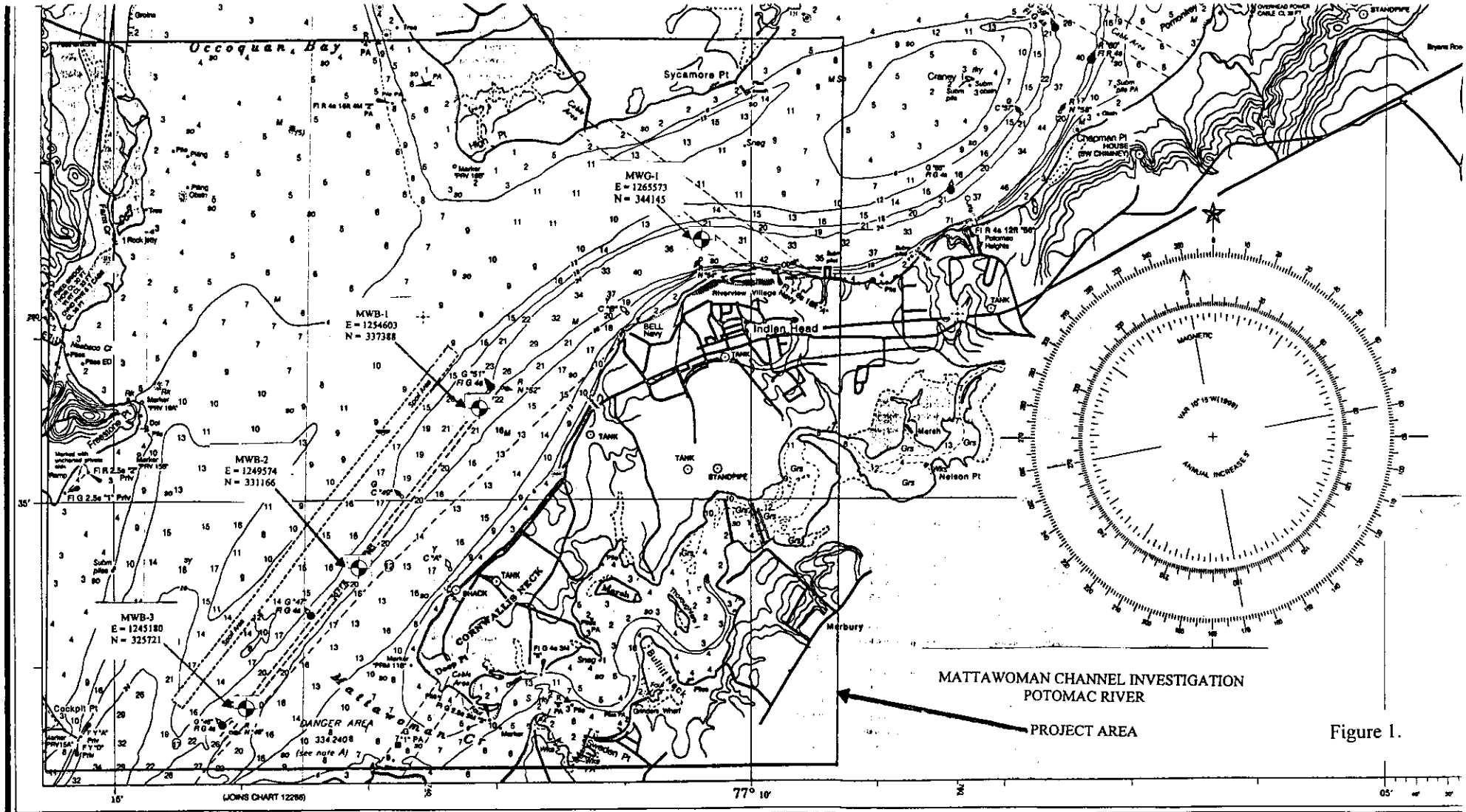
GRADATION CURVES

PROJECT: Ptomac River
Mattawoman Channel Investigation

AREA: Ptomac River, MD

Boring No.: MWB-3A

DATE: May 1999



MATTAWOMAN CHANNEL INVESTIGATION
POTOMAC RIVER

PROJECT AREA

Figure 1.

47th Ed., Mar. 14 / 98 ■

12289

CAUTION

This chart has been corrected from the Notice to Mariners published weekly by the National Imagery and Mapping Agency and the Local Notice to Mariners issued periodically by each U.S. Coast Guard district to the date shown in the lower left hand corner.

SOUNDINGS IN FEET

Published at Washington, D.C.
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
COAST SURVEY